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Tick tock: Rods help set internal clocks, biologist says

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We run our modern lives largely by the clock, from the alarms that startle us out of our slumbers and herald each new workday to the watches and clocks that remind us when it's time for meals, after-school pick-up and the like.

In addition to those ubiquitous timekeepers, though, we have internal "clocks" that are part of our biological machinery and which help set our circadian rhythms, regulating everything from our sleep-wake cycles to our appetites and hormone levels. Light coming into our brains via our eyes set those clocks, though no one is sure exactly how this happens.

But a Johns Hopkins biologist - working in collaboration with scientists at the University of Southern California and Cornell University -- unlocked part of that mystery recently. Their study found that rod cells - one of three kinds of exquisitely photosensitive cells found in the retina of the eye - are the only ones responsible for "setting" those clocks in low light conditions. What's more, the study found that rods - which take their name from their cylindrical shape - also contribute (along with cones and other retinal cells) to setting internal clocks in bright light conditions. The study appeared in a recent issue of Nature Neuroscience.

These findings are surprising for several reasons, according to study leader Samer Hattar of the Department of Biology at the Krieger School of Arts and Sciences.

"One is that it had previously been thought that circadian rhythms could

only be set at relatively bright light intensities, and that didn't turn out to be the case," he explained. "And two, we knew going in that rods 'bleach,' or become ineffective, when exposed to very bright light, so it was thought that rods couldn't be involved in setting our clocks at all in intense light. But they are."

In the study, Hattar's team used a group of mice which were genetically modified to have only rod photoreceptors, meaning their cones and intrinsically photosensitive retinal ganglion cells -- both of them light-sensitive cells in the animals' retinas -- were not functional. The team then exposed the rodents to varying intensities of light, measuring the animals' responding level of activity by how often they ran on hamster wheels.

The study results are important because they indicate that prolonged exposure to dim or low light at night (such as that in homes and office buildings) can influence mammals' biological clocks and "throw off" their sleep-wake cycles. Hattar suggested that one way people can mitigate this effect is to make sure to get some exposure to bright day light every day. (The exposure to brighter, natural daylight will firmly reset the clocks to a proper asleep-at-night-awake-in-the-day cycle.)

In addition, the study has possible implications for older people being cared for in nursing homes and hospitals, he said.

"Older adults often lose their rod cells to age, which means that their caretakers would be well advised to regularly and deliberately expose them to bright natural daylight in order to make sure that their natural, biological rhythms remain in sync so their sleep-wake cycles remain accurately set," Hattar said. "Otherwise, they could have sleep disturbances, such as intermittent waking or difficulty falling asleep, not to mention the impact on their appetite and other bodily functions."

Provided by Johns Hopkins University